

**THE LIFE HISTORY OF *PIERPHULIA ROSEA ANNAMARIEA*,  
AN UNUSUAL BUTTERFLY FROM THE PERUVIAN  
ALTIPLANO (LEPIDOPTERA: PIERIDAE)**

ARTHUR M. SHAPIRO AND STEVEN P. COURTNEY

Department of Zoology, University of California,  
Davis, California 95616 and

Department of Biology, University of Oregon,  
Eugene, Oregon 97403

*Abstract.*—*Pierphulia rosea annamariea* is a very small pierine from the Peruvian highlands, whose entire life history is highly aberrant. The egg, larva, and pupa and various aspects of the behavior and ecology of immatures and adults are described. The larva, a Crucifer feeder, is skipper-like in appearance and habits and lives in an individual silken nest within rosettes of the host. The pupa is rounded and is formed in a loose cocoon. Adults lay very few, very large eggs but may live more than three weeks. Growth is exceptionally slow, requiring as much as half again longer from egg to adult as pierines twice the size, reared under the same conditions.

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This is the fourth in a series of papers describing the preparatory stages of the Pierini of the Andean region. This tribe has undergone an extraordinary adaptive radiation in the Andes, with nine endemic genera and about 45 species in non-tropical or high-altitude tropical habitats, from northeastern Colombia to Tierra del Fuego. Previous treatments have appeared of *Reliquia santamarta* Ackery (Shapiro, 1978a), *Tatochila xanthodice* Lucas (Shapiro, 1978b), and the *sterodice* Stgr. and *autodice* Hbn. species-groups of *Tatochila*, comprising six entities (Shapiro, 1979).

The genus *Pierphulia* Field, formerly included in *Piercolias* Stgr., contains three species known from 3,000 to 5,000 m in the central Andes (Peru, Bolivia, and far northern Chile). At the time of the revision by Field and Herrera (1977), the only "natural history" available for any *Piercolias* was a vague, general habitat description for two species, and the life histories of all were unknown. Adult *Pierphulia* resemble miniature versions of *Piercolias*; they vie with the related genus *Infraphulia* Field as the smallest Pieridae in the world, with forewings 11–15 mm long. Like other small Andean Pierini, they show reduced venation ( $R_{4+5}$  anastomosed with  $R_3$ ).

*Pierphulia rosea annamariea* Field and Herrera, 1977 is locally common in the Aguadas Blancas Reserve, Department of Arequipa, Peru (ca. 16°30'S), where Shapiro (1985) studied its behavior and ecology in 1983. In July 1984 several females were collected there and transported to Davis, California where oviposition was obtained. Larvae were reared in plastic Petri dishes (14 × 2.5 cm) as described below, in a growth chamber under 10L:14D, 23.9°/12.8°C. Culture is difficult, as discussed below. Preserved early stages are being retained at Davis at this time for comparative studies of chaetotaxy and development. Color descriptions were prepared from life. Those in parentheses refer to the system of Kornerup and Wanscher (1978).

## DESCRIPTIONS

*Egg* (Fig. 1). Typically pierine in form; erect, milk-bottle-shaped,  $1.20 \times 0.33$  mm, the chorion sculptured as figured, with about 17 vertical and 45 horizontal ribs. Laid singly out of sight on the under surfaces of leaves within small Cruciferous rosettes. Light orange ("reddish orange," 7A8) when laid, turning slate gray 12 h before hatch. The larva exits by the upper part of the egg, usually below the apex, but does not consume any more of the chorion than is necessary for this purpose; it thus leaves a superficially intact "eggshell," unlike most Pierini. Time to hatch, 6–7 days.

*Larva: First instar* (Fig. 2). At hatch 1.45 mm at rest. Buff gray ("pale orange," 5A3) with head black and apparently unpatterned; body becoming blue-green ("grayish green," 26B4) after feeding. There is a darker, more heavily sclerotized "cervical shield" on the prothorax dorsally, which is more conspicuous in preserved specimens than in life. Body with numerous small black tubercles bearing pale hairs. The larva excavates pits in soft tissue of any part of the plant, and constructs a very rudimentary silken mat on which it sits. Length of instar, 4 days.

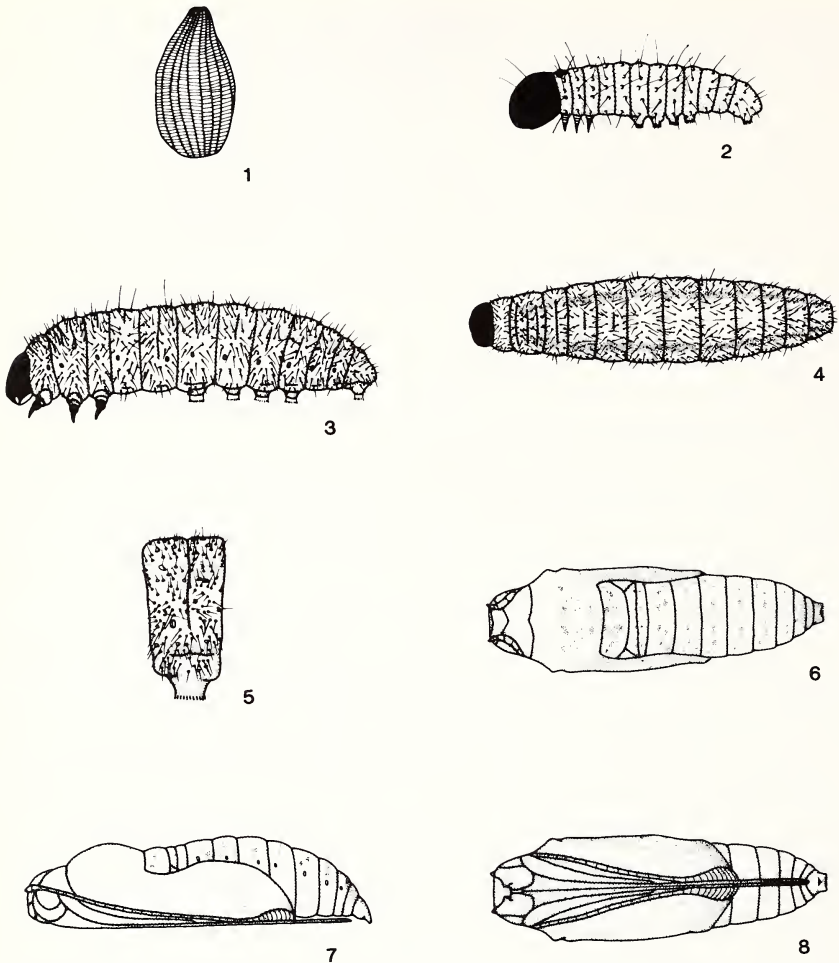
*Second instar*. After molt 3.2 mm long. Gray-green ("grayish green," 26C3) with an extremely faint pattern consisting of yellowish dorsal and subdorsal lines. Head and cervical shield brownish-black, vaguely lighter mottled. In this instar the larva constructs a loose silken shelter among the leaves near the apex of the rosette, within which it feeds, defecates, and molts. Length of instar, 4 days.

*Third instar*. After molt 5.1 mm. Similar but darker slate gray ("greenish gray," 26C2) sometimes with a vague purplish tinge, varying to blackish; the pattern only weakly contrasting, the cervical shield less distinct especially in darker individuals. Constructs a new nest after molting. Length of instar, 6 days.

*Fourth instar*. After molt 8.9 mm. As before, the pattern faint and most conspicuous in the darkest specimens (which are almost black). Again constructs a new nest after the molt. Length of instar, 8 days.

*Fifth instar* (Figs. 3–5). Initially 12 mm long, reaching 18 mm at maturity. Head dark purplish brown ("violet brown," 10E5) vaguely lighter mottled; mouthparts lighter gray brown ("brownish orange," 7C3). Body varying from purplish brown ("violet brown," 10E5) to brownish-black ("violet brown," 10F4) with an extremely faint middorsal line; slightly more contrasting but ill-defined subdorsal lines; a darker shade between the subdorsal and the spiracular area, which is greenish gray (1C2), occasionally with a vague darker line running through it at the level of the spiracles. Venter greenish gray (1C2) to light purplish brown ("violet brown," 11E4). True legs black, prolegs purplish brown externally and greenish gray on inner surface; crochets black. Cervical shield not contrasting. Body with numerous black tubercles of three sizes, more or less conical, bearing short gray simple hairs. Length of instar 10 days. The larva occasionally forages outside its nest in this instar. The last 1–3 fecal pellets are pinkish.

*Prepupa*. Variously disposed, vertical (head up) or horizontal; attached in the usual pierid fashion by the anal prolegs and a silken girdle around the thorax and wing-cases; within a very flimsy, transparent, net-like cocoon of white silk, often incorporating plant material or debris, or within the last larval nest. Color purplish brown ("violet brown," 11E5) with all markings very obscure, the ventral side of the thorax paler. Time to pupation 30 hr.



Figs. 1-8. *Pierphulia rosea annamariea* from Department of Arequipa, Peru. 1. Egg. 2. Newly hatched larva showing primary tubercles and setae. 3. Mature larva, lateral view. 4. Mature larva, dorsal view. 5. Mature larva, lateral view of seventh segment. 6. Pupa, dorsal view. 7. Pupa, lateral view. 8. Pupa, ventral view.

*Pupa* (Figs. 6-8). Length 12.8 mm; width at girdle 3.3 mm. Head and all appendage-cases dark slate green ("dull green," 26E3); abdomen brownish lilac ("grayish ruby," 12C4); wings often with some dark filling between veins, scarcely contrasting. Pupa with numerous black tubercles disposed in rows, corresponding to those of the larva; spiracles black; cremaster light purplish brown. Tongue-case very long, reaching or surpassing the penultimate segment; dorsal midline very weakly carinate on the thorax, scarcely at all on the abdomen; no frontal and only weak supraocular prominences; no flaring supraspiracular prominences; "shoulders" at bases of wings moderately pronounced. The pupa "looks teneral" until the pharate adult develops, be-

cause its color scheme is very similar to that of many Andean pierine pupae immediately after the molt. It wriggles very actively if disturbed. Eyes, wings, and body receive adult pigment in that order, with white appearing in the wings 24 hr and black 12 hr before eclosion. Meconium pink (12A3). Time to eclosion, 15 days.

#### DISCUSSION

Hardly anything about the biology of *Pierphulia rosea annamariea* is typical of the Pierini, Andean or otherwise.

Despite their small size and delicate appearance, adults are very hardy. Wild-collected females lived for over three weeks in captivity if fed daily and refrigerated at 2°C each night, and laid eggs every day until they died. Those eggs are, relatively speaking, the largest known in the Pieridae (and rival certain hesperiids); they are as large as or larger than the eggs of *Pieris* (*sens. lat.*) or *Tatochila* species twice their adult size. Only 3–5 eggs are laid/day when the opportunity is present to oviposit daily. In the field oviposition is often impeded by bad weather, and eggs can be accumulated up to 10–12. Lifetime egg production may frequently rival shorter-lived species which mature more eggs faster.

Captive females require very specific conditions for oviposition, both as regards thermal and light tolerances and substrate. After much trial and error, we found that they will lay freely on small (2–5 cm diameter) rosettes of the common weedy Crucifer *Lepidium virginicum* L., which also is acceptable for full development. Larvae reared on watercress, *Rorippa nasturtium-aquaticum* Schinz. & Thell., or seedlings of black mustard, *Brassica nigra* (L.) Koch., failed to survive to the fourth instar. The roots of the rosettes were kept wrapped in wet paper. They, the butterflies, and dandelion flowers (*Taraxacum officinale* Wigg.) were placed either in 14 × 2.5 cm plastic Petri dishes or 10 × 10 × 6 cm opaque plastic refrigerator boxes, both lined with rough paper toweling and both with transparent mesh tops, at 24°C with relative humidity ca. 30% in diffused or indirect sunlight. We were very surprised to see many eggs laid in the dandelion flowers, deep among the rays. This was done only in the immediate presence of Crucifers, and the larvae would not feed on the flowers. When ovipositing, the female stands “on tiptoe” with wings fully spread in the thermoregulatory “dorsal basking” posture, and probes deeply by bending the long ovipositor under leaves below the body. One female seemingly became habituated to laying in dandelions; after her 8th day in captivity she would hardly ever lay elsewhere, and she often fed and oviposited at the same time. We have seen the same behavior, albeit less frequently, in other small Andean Pierini. Either the cues received by the ovipositor are purely textural, or *P. rosea* can detect Crucifer chemistry at a distance of 2 cm or so without direct contact, but clearly the chemistry alone is insufficient as an oviposition stimulus since virtually no eggs were ever laid on non-rosette Crucifers, including *Lepidium* tops in various phenophases. The only known host plant in the wild is a very minute pinnatifid rosette Crucifer tentatively identified as a species of *Descurainia*.

The larva is sluggish and secretive, living in an individual web within the rosette. This nest usually incorporates the terminal bud, and by the time the larva is mature all the tender young tissue around it has usually been consumed. A new nest is built after each molt, but often directly adjacent to the old one. A few larvae left the



original host in later instars and migrated to another. Feeding occurs both by day and night in our rearing conditions, but in the wild may be inhibited at night by subfreezing cold. Growth is the slowest we have ever seen in any pierine; at 10L:14D, 23.9°/12.8°C, *P. rosea annamariae* takes 20% longer to mature than sympatric *Tatochila sterodice macrodice* Stgr. (more than twice its size) reared alongside it. It also takes half again longer than non-diapause *Pieris occidentalis nelsoni* Edwards from subarctic Alaska (Shapiro, 1975a, b), which resembles many Arctic-Alpine organisms in showing very rapid growth under mild conditions. No evidence of diapause was obtained, nor does it seem to occur afield, where there are 3–4 generations/yr depending on altitude, spanning both wet and dry seasons. Much of the high-Andean pierid fauna is tied to the peat bogs (*Turberas altoandinas*, Shapiro, 1985) which remain wet through the dry season, so continuous breeding is possible.

When mature, about half the larvae left the host and wandered for several hours before spinning the cocoon. Others simply enlarged the last larval nest, being careful, however, to pupate in an area free of frass. At least two larvae which deserted their nests wandered within their Petri dishes and then returned to the nests to pupate. This was probably an artifact of confinement. After one teneral pupa was partially eaten by a mature larva, all fifth instars were placed in individual dishes. The mature larva appears bloated, with a very small head, and superficially resembles a large curculionid larva or a hesperiid. Commencing in the first instar, the larva when not feeding usually rests in a coiled, head-to-tail posture very similar to a hesperiid in its nest. This combines with the nest-making habit and the cervical shield to create a powerful impression of convergence with that family. The roundness of the pupa is also skipper-like. It carries to an extreme the tendency seen in *Tatochila* for the reduction of the pupal prominences—a tendency also seen in the coliadine genus *Nathalis* Bdv., also of apparent high-Andean origin, and also greatly reduced in size.

In short, *P. rosea annamariae* differs from all other Pierini described to date in the following life history characteristics: 1. Small daily production of very large eggs. 2. Failure of the first instar larva to eat the chorion. 3. Reduced and simplified larval pattern. 4. Individual larval silken nest. 5. Individual silken cocoon. 6. Very slow growth. 7. Rounded pupa lacking nearly all the usual prominences.

In addition to the morphological oddities of the adult (Field and Herrera, 1977), it also has atypical mate-rejection behavior which is probably related to its unusual thermoregulatory posture (Shapiro, 1985; Shapiro and Courtney, 1985). All of these oddities are probably highly derivative, and reflect an integrated adaptive syndrome related to life in the *altiplano* (Shapiro, 1986).

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